Ex. 6 Personal Privacy (PP) Refereces to GSA Special Paper 182

GSA SPECIAL PAPERS

Recent Trends in Hydrogeology

Author(s) T. N. Narasimhan

Geological Society of America

Volume 189

DOI: https://doi.org/10.1130/SPE189

ISBN print: 9780813721897

Publication date: January 01, 1982

https://pubs.geoscienceworld.org/books/book/335/Recent-Trends-in-Hydrogeology

ABSTRACT

A number of important ideas, developed during the past 100 years, form the framework of the present understanding of regional ground-water flow. The most important of these ideas are:

Differences in topographic elevation provide the principal driving force for regional flow.

Flow through confining layers forms an essential element of regional flow systems.

Chemical evolution within the flow systems can be used to understand the flow.

Moving ground water is an efficient transport mechanism for heat within the Earth.

We trace the evolution of these ideas in the United States and demonstrate their influence on the present-day understanding of flow systems with examples taken primarily from the American literature.

Perry Rahn, "Permeability of the Inyan Kara Group in the Black Hills Area and Its Relevance to a Proposed In-Situ Leach Uranium Mine", Proceedings of the South Dakota Academy of Science, Vol. 93 (2014) p. 28

From the Geological Society of America Special Paper 189 (1982) entitled "Regional Ground-Water Flow Concepts in the United States: Historical Perspective"

U.S. Environmental Protection Agency in EPA/625/R-93/002, February 1993, "Wellhead Protection: A Guide for Small Communities, p. 18

"1. Differences in hydraulic head produced by topographic relief on the boundaries of the flow system are, in most instances, the driving force for the flow.

2. Most naturally occurring earth materials have finite permeability; there are no totally impermeable materials. In sedimentary deposits [which these Uranium deposits are] significant quantities of flow commonly occur through shaley confining layers." (P. 297)

Although relatively small when compared with the entire region of the Black Hills, this geographic area planned to be mined by Powertech/Azarga does play a role in the water recharge area of many aquifers. These aquifers have an influence on the entire state of South Dakota so the reach of the contamination will be much larger than anticipated or modeled. As stated on page 299 of Special Paper 189 as previously noted:

"The Dakota aquifer in South Dakota is the classic artisian aquifer. Many modern ideas concerning artesian aquifers stem from N.H. Darton's investigation of the Dakota aquifer during the 1890s and early 1900s. Darton recognized that the recharge to the system occurred in the Black Hills in western South Dakota while the major discharge was in eastern South Dakota, 300-500 km to the east."

N. H. Darton (1865-1948) studied extensively the geology of the Great Plains and Rocky Mountain Region, and is considered one of the most prominent geologists of the twentieth century. Darton is further quoted in Special Paper 189 as saying:

"Another factor which undoubtedly somewhat influxes the hydraulic grade in the Great Plains region is a certain but unknown amount of general leakage through the so-called impermeable strata, especially when under great pressure."

There are two issues in question here: pressure and leakage. The pressure in this case is the pressure of gravity as the potentiometric maps of South Dakota, particularly Darton's from 1909, which have never been disproven, show the flow going from West to East, or from the higher elevation to the lower, from the Black Hills to Eastern South Dakota. Although the land area in question in this proposal to mine is on the southwestern side of the Black Hills, in a study by Daniel G. Driscoll, Hydrology of the Black Hills Area, South Dakota, Issue 2, Parts 4094-4095, p. 112, the ground flow turns at the base of the Black Hills from going southwest and turning to the east. Again, this will impact other aquifers as stated by Darton and especially aquifers in Eastern South Dakota where the majority of population lives and the majority of farming occurs.

[…]

Furthermore, the chemical reactions that will be occurring with the addition of lixiviant will occur not just to the Uranium deposits but also with other elements present in the soil. This is further reiterated in Special Paper 189 as stated previously:

"3. Chemical reactions within the flow system occur in the moving fluid-ground water. The chemical evolution within the system can be utilized to understand the flow better."

This is the very idea behind ISR mining and the proposal by Powertech/Azarga. South Dakota School of Mines and Technology Professor Perry Rahn in a paper presented to the South Dakota Academy of Science adds:

"The chemistry of groundwater at an abandoned ISL uranium mine will be changed from its pre-mine condition. The amount of chemical change and the groundwater velocity downgradient from the mined site are important for any environmental assessment. The chemistry of this water will be greatly altered. Elements such as uranium, radium, and selenium will be dissolved by chemicals during the mining operation. These elements originally were bound up within the Inyan Kara aquifer as solid minerals. Solution mining will set them free as dissolved constituents in the groundwater. Their concentration and mobility within the aquifer is uncertain. The ultimate fate of groundwater contaminants from an ISL uranium mine depends on the groundwater velocity and the natural attenuation that could immobilize contaminants such as uranium and selenium."

Perry Rahn, "Permeability of the Inyan Kara Group in the Black Hills Area and Its Relevance to a Proposed In-Situ Leach Uranium Mine", Proceedings of the South Dakota Academy of Science, Vol. 93 (2014) p. 28

Recommendation: The EPA should require research with the aid of electron microscopes and mass spectrometers to ascertain the presence of Uranium isotopic ratios and Tritium that are characteristic of the Dewey-Burdock area and their presence in wells in the James River area of Eastern South Dakota. This would show if such elements have already traveled from the Dewey-Burdock Uranium mining area to the Eastern side of South Dakota. Of course, other radioactive pollutants should also be studied as well, particularly the naturally-occurring daughter products of Uranium 238. If the studies show that radioactive polutants have already traveled to Eastern South Dakota via the aquifers through old, traditional mining practices, then the information would raise the question of how much more pollution would travel in the ground-water with ISR mining whose process directly affects groundwater. Such a study needs to occur prior to any consideration for an ISR mining operation anywhere in the Black Hills. ISR mining would impact the quality of ground water much more extensively than old open-pit mining.

As most of the water use in western and much of eastern South Dakota, and especially in this proposed ISR mining activity is tapped into the groundwater, it would behoove the protection of all groundwater. As stated by the U.S. Environmental Protection Agency in EPA/625/R-93/002, February 1993, "Wellhead Protection: A Guide for Small Communities, p. 18:

"Well protection emphasizes the prevention of drinking water contamination as a principal goal, rather than relying on correction of contamination once it occurs..."

Because of the above stated reasons and recommendation on the groundwater alone, the well permits and aquifer exemption must NOT be granted as any disturbance by radioactive pollution will have a far reaching and long lasting effect that would precipitate a system-wide ecological reaction of unpredictable scope and dimension for thousands of years.